Nipah Virus Infection Among Military Personnel Involved in Pig Culling during an Outbreak of Encephalitis in Malaysia, 1998–1999

To the Editor: An outbreak of severe encephalitis affecting 265 patients, 104 (40%) of whom died, occurred during 1998-1999 in Malaysia. It was linked to a new paramyxovirus, Nipah virus, which infects pigs, humans, dogs, and cats (1-4). Nipah virus is most closely related to Hendra virus (4), which was discovered in Australia in 1994 during an outbreak of severe respiratory disease among horses and humans (5-9). Most patients in Malaysia were pig farmers, and human infection was linked to exposure to pigs (10). An operation to cull the approximately 1 million pigs on farms in the outbreak-affected areas was carried out, primarily by 1,638 military personnel. After two soldiers involved in culling became ill with Nipah encephalitis, we conducted a cross-sectional survey of military personnel participating in culling activities in the outbreak-affected states of Malaysia (Negeri Sembilan and Selangor) to assess the prevalence of Nipah infection.

The survey was conducted approximately 2-4 weeks after the end of all culling activities to control the outbreak. All military personnel, enlisted and officers, who had been assigned to culling duty in the states of Negeri Sembilan and Selangor were invited to participate, regardless of specific job assignment. Study teams visited the military bases in each state and administered a survey asking about illness, specific exposures and activities during culling, use

of protective equipment such as gloves, and other pig exposures not associated with culling. A single serum specimen obtained at the time of the interview was tested for the presence of immunoglobulin (Ig) M and IgG antibodies against Nipah virus by enzyme immunoassays (EIA). IgM antibodies were detected by an IgM-capture EIA and IgG antibodies by an indirect EIA. Hendra virus antigens, which cross-react with antibodies against Nipah virus, were used in the serologic assays. In limited laboratory comparisons with Hendra virus and Nipah virus antigens, a good correlation was observed between the IgG and IgM EIA results.

Of 1,474 military personnel listed in the records of the military bases where the survey was performed, 1,412 (96%) responded to the survey and provided serum specimens. The mean age of the participants was 28.3 years (range 19 to 50 years). On average, the soldiers participated in culling for 8.2 days (range 1 to 60 days), for 7.4 hours per day (range 0.5 to 18 hours per day), and at 86 farms (range 1 to 696 farms). During culling, 63% reported physical contact with live pigs and 30.9% with dead pigs. The most common activities reported by the soldiers included shooting pigs (63.2%); herding, hitting, or carrying live pigs (60.5%); changing rifle magazines (39.4%); carrying dead pigs (25.8%); and spraying lime over pig burial sites (14.6%). More than 80% reported wearing gloves, masks, and boots, and 31% reported wearing goggles at all times during culling.

Six (0.4%) of the 1,412 personnel studied had detectable antibody against Nipah virus. All six had IgM antibody, and one also had IgG antibodies. Two of the six antibody-positive persons had been hospitalized with encephalitis during the culling operation. All the antibody-positive personnel were involved in culling in Negeri Sembilan state and reported direct physical contact with live pigs; none reported obvious contact with secretions or body fluids (e.g., blood and urine) of infected pigs. Four of the six antibody-positive persons also reported direct physical contact with dead pigs. All six reported wearing gloves, masks, and boots at all times while working, and three reported wearing goggles.

Comparison of exposures and activities among personnel involved in culling in Negeri Sembilan state (N = 960) and Selangor state (N = 497) showed that the former were more likely to report direct physical contact with both live pigs (69.4% vs. 57.0%, respectively, $p < 0.001$) and dead pigs (41.7% vs. 11.2%, respectively, $p < 0.001$). However, the reported prevalence of sick pigs on farms where pigs were culled did not differ between the two groups (68.6% versus 72.9%, respectively, $p = 0.50$). No significant differences were observed in use of personal protective equipment (gloves, boots, and mask) for those in Negeri Sembilan compared with Selangor, except for wearing goggles (34.8% versus 76.4%, respectively, $p < 0.001$).

Our findings indicate that transmissibility of Nipah virus to military personnel involved in pig culling was low. Four of the six infected persons were apparently well; follow-up of these and the other infected soldiers will be important to determine if any symptoms of disease or long-term sequelae develop. The observation that all the infected persons reported direct contact with live pigs is consistent with the hypothesis that transmission of Nipah virus to humans most likely occurs from close contact with infectious secretions or body fluids of pigs. Respiratory secretions and urine of infected pigs have been shown to contain Nipah virus and may be vehicles of transmission (1,2,4).

We could not document the route of infection for the antibody-positive personnel. Although all six antibody-positive persons reported wearing gloves, masks, and boots while culling, three did not report wearing goggles. Exposure may have occurred through inoculation of the conjunctiva with infectious secretions of pigs; however, bias in reporting use of other protective equipment should also be considered. Given the great severity of Nipah encephalitis and the possible, although small, risk of transmission of virus to military personnel involved in culling, we recommend great care in handling potentially Nipah-infected pigs during such operations.

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References

1. Centers for Disease Control and Prevention. Outbreak of Hendra-like virus–Malaysia and Singapore, 1998-1999. MMWR Morbid Mortal Wkly Rep 1999;48:265-9.
2. Centers for Disease Control and Prevention. Update: Outbreak of Nipah virus–Malaysia and Singapore, 1999. MMWR Morbid Mortal Wkly Rep 1999;48:335-7.
3. Chua KB, Goh KJ, Wong KT, Kamarulzaman A, Tan PS, Ksiazek TG, et al. Fatal encephalitis due to Nipah virus among pig-farmers in Malaysia. Lancet 1999;354:1257-9.
4. Chua KB, Bellini WJ, Rota PA, Harcourt BH, Tamin A, Lam SK, et al. Nipah virus: a recently emergent deadly paramyxovirus. Science 2000;288:1432-5.
5. Murray K, Selleck P, Hooper P. A morbillivirus that caused fatal disease in horses and humans. Science 1995;268:947.
6. Murray K, Rogers R, Selvey L, Selleck P, Hyatt A, Gould A, et al. A novel morbillivirus pneumonia of horses and its transmission to humans. Emerg Infect Dis 1995;1:313.
7. Selvey LA, Wells RM, McCormack JG, Ansford AJ, Murray K, Rogers RJ, et al. Infection of humans and horses by a newly described morbillivirus. Med J Aust 1995;162:642-5.
8. Hooper PT, Gould AR, Russell GM, Kattenbelt JA, Mitchell G. The retrospective diagnosis of a second outbreak of equine morbillivirus infection. Aust Vet J 1996;74:2445.

9. Rogers RJ, Douglas IC, Baldock FC, Glanville RJ, Seppanen KT, Gleeson LJ, et al. Investigation of a second focus of equine morbillivirus infection in coastal Queensland. Aust Vet J 1996;74:2434.
10. Parashar UD, Lye MS, Ong F, Mounts AW, Arif MT, Ksiazek TG, et al. Case-control study of risk factors for human infection with a new zoonotic paramyxovirus, Nipah virus, during a 1998-1999 outbreak of severe encephalitis in Malaysia. J Infect Dis 2000;181:1755-9.